

CLAIMS

What is claimed is:

1. An apparatus for contacting a plurality of objects with a fluid, said apparatus comprising:

5 a vessel having at least one bottom wall inclined downwardly from at least one sidewall to an inlet for providing an upwardly directed stream of said fluid capable of causing said objects to flow upward to a disengaging position from a feed position adjacent to said inlet when a bed of said objects are moving downwardly along said bottom wall away from an upper portion thereof to said feed position and said flow  
10 of objects is being disengaged from said stream at said disengaging position; and

15 a distribution shield mounted in said vessel and having an upper surface inclined downwardly and extending away from the vicinity of said disengaging position to a return position above the upper portion of said inclined bottom wall, such that said disengaged objects fall on the upper surface of said distribution shield and move downwardly thereon to said return position from which they are deposited onto the upper portion of said inclined bottom wall and move downward along said  
20 inclined bottom wall toward said feed position.

2. An apparatus according to claim 1 further comprising a conduit mounted in said vessel and arranged above said fluid inlet for receiving said flow of objects, said conduit extending upwardly to confine the flow of said objects from  
5 said feed position to at least the vicinity of said distribution shield.

3. An apparatus according to claim 2, wherein said  
5 bottom wall has a conical shape and is substantially surrounded by said sidewall, and wherein an upper portion of said distribution shield is connected to an upper portion of said conduit.

Sub 22  
5 L 4. An apparatus according to claim 1 for coating said objects with a metal, wherein said fluid is a liquid electrolyte comprising said metal and said objects are at least partially electrically conductive, and wherein said apparatus further comprises an electrode positioned to contact said moving bed and a counterelectrode positioned above and in spaced relation to said moving bed.

4. An apparatus according to claim <sup>3</sup>~~4~~, wherein said electrode comprises a sheet of electrically conductive material covering a substantial portion of said bottom wall and arranged to contact said moving bed of objects.

5. An apparatus according to claim <sup>3</sup>~~4~~, wherein said counterelectrode is located under said distribution shield and includes means for preventing said objects from being retained on an upper surface of said counterelectrode.

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L 7. An apparatus according to claim 6 further comprising a deflecting member mounted below said counterelectrode so as to intercept objects carried upward by currents of said fluid and deflect them away from said counterelectrode.

1. An apparatus according to claim <sup>3</sup>~~4~~, wherein said distribution shield and said counterelectrode are detachably suspended in said vessel and are removable to permit the objects in said moving bed to be removed from said vessel.

5 8. An apparatus according to claim 1, wherein said vessel includes fluid outlet means for discharging said fluid from said vessel; and wherein said apparatus further comprises means for sequentially supplying to said vessel inlet a plurality of fluids each from a corresponding source, and means for returning each of said fluids from said vessel

outlet means to said corresponding source from which the fluid was supplied.

<sup>9</sup>  
~~10~~. An apparatus according to claim <sup>8</sup>~~9~~, wherein said sequential supply means comprises means for detachably mounting said vessel sequentially on each of a plurality of containers each of which constitutes the corresponding source  
5 of one of said fluids.

<sup>10</sup>  
~~11~~. An apparatus according to claim <sup>9</sup>~~10~~, wherein said sequential supply means further comprises pump means for conveying to said vessel inlet fluid from the container on which said vessel is mounted, control valve means for  
5 controlling the flow of fluid from said mounting container to said vessel inlet, and a frame for supporting said vessel, said pump means and said valve means as a portable unit for transfer between said plurality of containers.

12. An apparatus according to claim <sup>8</sup>~~9~~ further comprising a supply conduit connected to said vessel inlet, a bypass conduit connected to said supply conduit for recycling at least a portion of the fluid in said supply conduit to the  
5 corresponding source, and a control valve for controlling fluid flow in said bypass conduit so as to regulate the amount of fluid flow reaching said vessel inlet.

<sup>8</sup>  
13. An apparatus according to claim <sup>8</sup>~~9~~, wherein said fluid is a liquid and said vessel is open to the atmosphere, and wherein said outlet means comprises a channel extending along the exterior of said sidewall and a weir for maintaining  
5 a predetermined liquid level in said vessel by providing an overflow for releasing to said channel liquid reaching said liquid level.

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11 14. An apparatus according to claim 10, wherein said vessel is a portable structure comprising a fitting for connecting said inlet to a conduit for supplying said fluid to said vessel, wherein said mounting means is arranged to detachably support said vessel sequentially on each of said containers, and wherein each of said containers comprises a supply conduit, pump means for pumping fluid from said container to said supply conduit, and valve means for controlling the flow of fluid from said supply conduit to said vessel inlet.

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15. An apparatus according to claim 1 further comprising a plurality of containers each for containing a corresponding treating solution to be used in the treating of said objects, pump means for circulating said treating solutions, an inlet manifold for respectively connecting an output of said pump means to each of said containers, an outlet manifold for returning the corresponding solution from an outlet of said vessel to the corresponding container, remotely operable valve means for respectively connecting said inlet manifold and said outlet manifold with one of said containers at a time, and control means for operating said valve means from a location remote therefrom.

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16. An apparatus according to claim 1 further comprising a mesh screen positioned relative to said vessel inlet to prevent a discharge of said objects through said vessel inlet in the absence of said fluid stream, and a filter for filtering said fluid upstream of said mesh screen.

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17. An apparatus according to claim 1 further comprising a particle trap providing a tortuous flow path upstream of said vessel inlet to prevent a discharge of said objects through said vessel inlet in the absence of said fluid stream.

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18. An apparatus according to claim 1 further comprising a deflecting member mounted above said distribution shield and located in the vicinity of said release position so as to intercept said upwardly flowing objects and deflect them away from said fluid stream.

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19. An apparatus according to claim 17, wherein said deflecting member has an inverted conical surface for intercepting and deflecting the objects.

19  
20. An apparatus according to claim 1, wherein said bottom wall and said distribution shield are each inclined at an angle in the range of about 20° to about 50° from the horizontal.

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21. An apparatus according to claim 1, wherein the fluid in said vessel is a mixture of a liquid and a gas, and wherein said distribution shield has a lower surface which is inclined upwardly away from said fluid stream and toward said sidewall to prevent an accumulation of the gas under said distribution shield.

21  
22. An apparatus according to claim 1 further comprising a conduit mounted in said vessel and arranged above said fluid inlet for receiving said flow of objects, wherein said conduit extends upwardly to confine the flow of said objects from said feed position at least to the upper surface of said distribution shield, wherein the said fluid in said vessel is a mixture of a liquid and a gas, and wherein vent means is provided to prevent an accumulation of the gas under said distribution shield by providing a flow path for said gas from below to above said distribution shield.

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23. An apparatus for electrolytically treating a plurality of objects with an electrolytic fluid while immersed in said fluid, said objects being at least partially electrically conductive and said apparatus comprising:

5 a vessel having at least one bottom wall inclined downwardly from at least one sidewall to an inlet for providing an upwardly directed stream of said fluid capable of causing said objects to flow upward to a disengaging position from a feed position adjacent to said inlet when a bed of said  
10 objects are moving downwardly along said bottom wall away from an upper portion thereof to said feed position and said flow of objects is being disengaged from said stream at said disengaging position;

15 an electrode positioned to contact said moving bed and a counterelectrode positioned above and in spaced relation to said moving bed;

pump means for conveying fluid from a container to said vessel inlet;

20 control valve means for controlling the flow of fluid from said container to said vessel inlet; and

a frame for engaging said container and supporting thereon said vessel, said pump means and said valve means to provide a portable unit for transfer between a plurality of containers.

23  
24. An apparatus according to claim 23 further  
comprising a distribution shield mounted in said vessel and having an upper surface inclined downwardly and extending away from the vicinity of said disengaging position to a return  
5 position above the upper portion of said inclined bottom wall, such that said disengaged objects fall on the upper surface of said distribution shield and move downwardly thereon to said return position from which they are deposited onto the upper portion of said inclined bottom wall and move downward along  
10 said inclined bottom wall toward said feed position.

<sup>24</sup>  
25. An apparatus according to claim <sup>23</sup>~~24~~ further comprising a conduit mounted in said vessel and arranged above said fluid inlet for receiving said flow of objects, said conduit extending upwardly to confine the flow of said objects from said feed position to at least the vicinity of said distribution shield.

<sup>25</sup>  
26. An apparatus according to claim <sup>23</sup>~~24~~, wherein said distribution shield and said counterelectrode are detachably suspended in said vessel and are removable to permit the objects in said moving bed to be removed from said vessel.

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27. An apparatus according to claim 24 further comprising a deflecting member mounted above said distribution shield and located in the vicinity of said release position so as to intercept said upwardly flowing objects and deflect them away from said fluid stream.

<sup>27</sup>  
28. An apparatus according to claim <sup>23</sup>~~24~~, wherein said counterelectrode is located under said distribution shield and includes means for preventing said objects from being retained on an upper surface of said counterelectrode.

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29. An apparatus according to claim 28 further comprising a deflecting member mounted below said counterelectrode so as to intercept objects carried upward by currents of said fluid and deflect them away from said counterelectrode.

<sup>29</sup>  
30. An apparatus according to claim <sup>22</sup>~~28~~, wherein said electrode comprises a sheet of electrically conductive material covering a substantial portion of said bottom wall and arranged to contact said moving bed of objects.